The Process of Problem Identification

The Process Begins

Every process, no matter how complex, has a starting point. In the CALFED Bay-Delta Program, the place to begin is with a clear statement of the problems that the program will seek to address in the coming three years. The problems with the Bay-Delta system have been defined in many ways, and often include issues such as the loss of native fish and wildlife, inability to receive water deliveries when needed, and the impacts of water pollutants on the health of the system. Problems and possible causes have been the subjects of many efforts including scientific studies, monitoring programs, planning processes and legislative actions. While there is still debate on what are the primary causes for many of the problems facing the Bay-Delta, there is growing agreement on the scope of the problems.

The Bay-Delta System in Decline

The San Francisco Bay/Sacramento-San Joaquin Delta is the largest estuary on the west coast of both North and South America. Because of its size and complexity, the system supports a wide diversity of fish, wildlife and plant life. It also supports important economic activities including commercial and sport fishing, shipping, industry, agriculture, recreation and tourism. As with any diverse ecosystem, problems exist for many of these competing uses and users of the Bay-Delta system.

Most observers agree that the Bay-Delta Estuary system is not functioning well—either as habitat for the region's important biological resources or as a key part of the state's water management and delivery system. Both these functions are vitally important to the economic and social well being of California.

The Bay-Delta's decline did not begin recently. One hundred years of immense changes have been wrought on the watershed and adjacent lands that support the estuary. The natural systems of the Bay-Delta have been under pressure from land use changes, water developments, impacts from industrial, urban and agricultural pollutants, fishing practices, introduced species and an array of other actions. Solutions to the problems and their causes will not be affected overnight.

The CALFED Bay-Delta Program Role

There are many reasons for the decline in the Bay-Delta's ability to support identified vital functions. Some causes are relatively well understood, while other causes are less clear and are the subject of on-going study and analysis. One thing is certain about the Bay-Delta—regardless of the specific causes for declines in biological value and water management utility, the current situation must be changed.

Efforts to bring about solutions to the problems facing the Bay-Delta system have been continuing for many years. Various responsible state or federal agencies and interest groups have taken direct action or have proposed actions to solve aspects of the problems facing the Bay-Delta system. Parties have put forward potential solutions to biological declines in the Bay-Delta, championed strategies to solve various water supply issues or sought to establish regulations addressing these issues. More integrated planning has occurred through efforts such as the San Francisco Estuary Project and the Governor's Bay Delta Oversight Council.

The CALFED Bay-Delta Program does not stand in isolation of these previous and continuing efforts. Rather, the program is an extension of the recent increase in coordination and cooperation that has characterized the actions of the many interest groups and agencies concerned with the Bay-Delta. Interest groups and agencies that historically have been greatly at odds are working together in processes that foster cooperation and the finding of mutually-acceptable solutions. This willingness by all parties to seek agreement on long-standing issues presents a major opportunity for government, key interest groups, and the concerned public to draft a lasting set of solutions for the problems facing the Bay-Delta system.

The CALFED Bay-Delta Program is charged with finding solutions to the most important set of problems now facing the estuary. The following summaries are intended to begin the process of defining the range and extent of problems which should be addressed through the program by briefly describing background and status on four key problem areas.

Summary of Four Identified Issue Areas

For ease of analysis and discussion, the problems facing the Bay-Delta system have been separated into four main categories. While these categories may be refined during the process, no matter what categories are used to describe problems in the system, all the problems eventually identified as part of the CALFED Bay-Delta Program are recognized as being related to one another. The problems also must be considered parts of a whole. Changes in water quality potentially affect biological resources. Changes in habitat might affect water supply or current Delta levee use and maintenance. Therefore, the following four issue areas are meant to help begin discussions on how to best define the important Bay-Delta problems to be considered by the CALFED Bay-Delta Program.

The Bay-Delta's **biological resources**—its habitats, aquatic species, and wildlife—have undergone major changes since the Gold Rush. These changes include habitat degradation and loss, population declines and the loss of many native species, and the introduction of hundreds of species of new plants and animals. Wetlands and the animals dependent on them have been particularly affected. Populations of many fish species have declined to their lowest levels, and the number of fish and wildlife species needing special protection is increasing.

There is a growing concern about the **vulnerability of the Delta levee system**. Levee failure would result in the flooding of productive Delta farm lands, loss of habitat for non-migrating waterfowl species and loss of wintering grounds for migrating species. Levee failure on certain islands would significantly impact water supply distribution systems.

Water quality in the Bay-Delta is a concern. Concentrations of many pollutants are elevated in the estuary's water, sediment, and living resources. The presence of both organic carbon and salts in the waters of the estuary is also of concern. These salts, entering the estuary through the Bay and ocean, decrease the utility of Delta waters for most purposes. The Delta is a source of drinking water for millions of Californians. Its water quality is critical not only for this use, but also for the state's agricultural and business sectors.

The **reliability** of water supplies available for municipal, industrial, environmental, and agricultural use is increasingly uncertain, due both to increasing human needs and recent requirements placed on the operation of water supply facilities in order to protect fish and wildlife.

Problem Area Summaries

- **Biological Resources**

Based on the accounts of explorers, trappers, and naturalists, the estuary's extensive wetlands and upland habitats supported a rich community of wildlife in the early 19th century. Large numbers of birds and mammals reflected the abundance and diversity of high quality habitats in the estuary watershed. Accounts describe a multitude of waterfowl "darkening the surface of the bays" and white geese giving the ground the appearance of being covered with snow. Many species now considered rare were common before or at the end of the century. Bald eagles nested in Sacramento in 1849, and in the 1900s nested in Santa Clara County and foraged along the Bay shoreline. Peregrine falcons and the California condor were often observed along the estuary. The estuary also supported a vast array of native resident and anadromous fish species such as salmon, steelhead trout, anchovies, flatfish, and herring.

Commercial fisheries were established in the mid 1850s. By the 1870s the striped bass and American Shad were introduced to increase fish production. By the century's end, the Bay Area was the center of a major fishing industry. As the 20th century progressed however, fish and wildlife populations began to decline. The estuary's fisheries became less diverse. As examples of this trend, commercial take of white sturgeon was banned in 1901; steelhead trout in 1927; striped bass in 1935 and American shad in 1957. Numbers and diversity of wildlife in the estuary also declined.

Over time, many of the habitats in the estuary and the basin have been converted or degraded. The extent of open water in the Bay has been reduced by a third, the number of acres of wetland habitats has decreased greatly, and more than half of the native upland habitats have been urbanized. Riparian woodland once lined the banks of many Delta channels, providing important habitat for many upland species and contributing to aquatic habitats. These woodlands were reduced as land was cleared for agriculture and levees constructed. These habitat changes have impacted the region's ability to support fish and wildlife populations. In addition, many new species of plants and animals have been intentionally (striped bass and American Shad) and accidentally (the Asian clam) introduced into the estuary. Most introductions make the ecological management of the estuary more difficult.

Water development has increased the salinity of water and soil throughout the Bay portion of the system. Populations of important resources such as salmon and striped bass have been affected by reduced quantity and quality of spawning and rearing habitat and changed migration routes. Loss of fish eggs and young in Delta diversions affects the population levels of many fish species.

Twenty-five years ago there were substantial areas of the Bay where low levels of dissolved oxygen and/or direct contact with pollutants killed fish. While direct fish kills are no longer observed, pollutants are causing less-than-lethal effects on fish and wildlife species.

A diverse array of fish, wildlife and plant species still inhabit the estuary and its surrounding lands. But great changes in water and land use have reduced the abundance of estuary species and their required habitats. By 1993, twenty-two wildlife species within the basin and two fish species were identified by state or federal agencies as either threatened or endangered.

- **Vulnerability of Levees and Channels**

The Delta as we know it today is largely a man-made landscape. Early explorers to California found there a vast tule marsh rich with fish and wildlife. The peat soils of the Delta proved to be excellent for agriculture and the landscape was transformed. Levees were first constructed in the Sacramento-San Joaquin Delta during the late 1800s, when settlers began to turn tidal marshes into agricultural land. Existing sand, silt, and organic levees, which had been naturally formed along Delta rivers and sloughs, were often used as the foundation for larger man-made levees. At first, these were built by hand using shovels and wheelbarrows, or by "scrapers" towed by horses. Many of these levees were built using any materials available, without appropriate construction methods or engineering design. By 1900, mechanical dredging was common and allowed for larger levee fills and the opening of new dredged channels throughout the Delta system.

Over time, both natural settling of the levees and *subsidence* (oxidation and compression which lowers the level of the land over time) of Delta island soils resulted in a need to increase levee heights to maintain protection. Many levees in the central and western Delta were improved with *berms* (flattened slopes added for more stability). Ditches were dug parallel to the levee to collect and control water seeping through the levee and its foundation.

In the Delta and along the edges of the Bay, levees are the most visible flood control feature. Most Bay levees prevent flooding of lands a few feet below sea level; those in the Delta protect lands as much as 20 feet below sea level. While sizes vary, most are from 10 to 25 feet in height with widths (measured at the top) between 15 and 25 feet.

Along the Bay shoreline and the Delta, levees greatly changed hydraulic conditions. In the Bay, they eliminated tidal flows into thousands of acres of seasonal wetlands while providing protection of developments within the floodplain. In the Delta, levees now keep more than 350,000 acres of seasonal wetlands from flooding. Because of the natural subsidence of the Delta islands, the lack of levees would result in the islands' eventually becoming open water areas.

Over 1,100 miles of levees now protect the low-lying islands and tracts in the Sacramento-San Joaquin Delta. The below-sea level elevations of many Delta islands reduces the stability of their adjacent levees. Progressive decline and loss of levee stability over time reduces the reliability of Delta levees under average climate conditions, and is of particular concern during times of high tides, floods, and earthquakes. One cause for floods is the lack of the channels' capacity to carry water.

There is a growing concern about the vulnerability of the delta levees to natural disaster. Levee failure would result in the flooding of farm land as well as loss of habitat for wildlife and loss of wintering grounds for migrating species. Loss of an island or tract would expose adjacent islands to increased wave action and possible levee erosion. Levee failure on certain islands would impact water supply distribution systems, such as the Mokelumne Aqueduct. Flooding of key Delta islands would increase the potential for sea water intrusion further up the Delta, especially in a low water year when less freshwater would be available to repel the incoming salt water. Such a failure could result in a lengthy halt to export and use of Delta water by both urban and agricultural users.

Local reclamation districts are concerned with the cost of maintaining and improving the levee and channel system. The complex array of agencies with planning, regulatory, and or permitting authorities over levees makes rehabilitation and maintenance efforts difficult.

- Water Quality

Before the arrival of Europeans, the few pollutants that entered the Bay-Delta Estuary came from natural sources such as the weathering of rocks, from oil seeps, and from the settlements of Native Americans along the shoreline. The effects of these pollutants were probably small and localized. The first major human-caused pollutant effect in the estuary occurred during the gold mining period between 1850 and 1884 (the year hydraulic mining was banned by the Legislature) when an estimated 3,500 tons of highly toxic mercury was used to extract gold in the process of hydraulic mining. Along with millions of cubic yards of sediments washed down streambeds by high-pressure hydraulic mining hoses, some of this mercury reached the estuary. By the turn of the century, untreated industrial and sewage wastes reduced water quality in many portions of the estuary. By the end of the Second World War, with industry and agriculture thriving and more people moving into the region, the estuary was receiving large and mostly uncontrolled amounts of sewage, industrial, urban and agricultural wastes. By the 1950s, parts of the estuary were in very poor condition. Algae growth fed by nutrients in wastewater led to reports of "rotten egg" odors along the shoreline. Throughout the estuary, studies indicated that pollutants were harming water quality and biological resources.

Efforts to control sewage effects did not begin in earnest until the early 1950s, when some publicly owned treatment plants began primary treatment of municipal wastewater. Since 1960, $3 billion has been spent on wastewater plant upgrades and sewage outflow consolidation and relocation. Implementation of the state and federal clean water laws led to rapid improvements in the quality of estuary waters during the 1970s. Between 1975 and 1985, "pretreatment" programs (reducing pollutants before they reach the municipal treatment plant) had reduced trace elements (such as copper and lead) being discharged from the plants by 37 to 92 percent.

The quality of water in the estuary is vital to the economy of California. The Delta is a source of drinking water for millions of Californians, and is critical to the state's business and agricultural sectors. Yet, despite progress, water quality issues remain a concern in the estuary. In addition to the pollutants entering the system, the presence of both organic carbon and salts in the waters of the estuary are of concern. These salts, entering the estuary through the Bay and ocean, decrease the utility of Delta waters for most purposes. Agricultural use of water exported to the San Joaquin Valley concentrates salts and returns them to the estuary as agricultural drainage.

Issues of human health exist regarding the waters of the estuary. The level of organic carbon in the water (thought mainly to result from the process of plant decay on many of the Delta's peat soil islands) is of concern because of the way organic carbon reacts with treatment chemicals in the process of treating drinking water. Potentially harmful "by-products" are created in this process, which in turn must be treated by water providers in order to achieve safe drinking water. Contaminants are found at high enough levels in some fish and wildlife species (such as mercury in striped bass) that public health warnings have been issued concerning public consumption of certain species.

Every day, thousands of pounds of pollutants continue to enter the estuary. They come from many sources, including sewage treatment plants, industrial facilities, forests, farm fields, mines, back yards and urban streets. They find their way to the estuary's most remote areas where they interact with water, sediment, plants and animals.

- Water Supply Reliability

Experience shows that water supply has often been uncertain in California. While no drought in this century has lasted longer than seven years, the analysis of tree rings tells us that periods of low rain and snowfall have lasted much longer in the distant past. Before humans settled the state and began storing and diverting fresh water for uses in cities and on farms, the estuary's freshwater flows were determined by rain and snowfall patterns and other natural processes. In average years, flows increased in late fall as rains swelled streams and rivers and continued to increase during the winter, peaking in spring with the Sierra snowmelt. The spring peak kept sea salts from entering the Delta, brought nutrients into estuary waters, and allowed fish to migrate, spawn and rear successfully.

Freshwater flows began to be modified shortly after the Gold Rush as miners in the Sierra diverted streams to supply giant water cannons used in hydraulic mining. By 1867, 300 streams were being diverted to supply water for the irrigation of nearby farms. The first major San Joaquin Valley agricultural diversion was built in 1852 along the Merced River. By 1890, more than one million acres of Central Valley land was being irrigated. During the next 80 years, the state's two huge water projects, the Federal Central Valley Project and the State Water Project, were constructed. Hundreds of other storage and diversion dams were built on Central Valley tributaries in the last century, including storage reservoirs for the major metropolitan areas of California. The overall effect of these actions has been to reduce the volume of water flowing downstream throughout the late fall, winter and spring, and to increase flows during the summer on major tributaries. Additionally, the effect of these actions has been slightly increased salinity levels in the western Delta and in Suisun Bay during winter and spring and decreased levels during summer and fall.

Water diverted upstream from the estuary's tributaries in the Central Valley and from the Delta is used to meet a large proportion of the state's water demand. In 1985, water diverted from these areas made up almost half of the state's total net water use.

The predictable availability of water is of major importance to urban and agricultural users. Businesses can't expand and farmers can't get bank loans without a predictable water supply. The timing of fresh water flow also greatly affects environmental conditions in the estuary. Volume and timing of freshwater affect the movement of water within the Delta, water quality, and the abundance of many species of plants and animals. Controlling the timing of supply has been a key objective for many of the major water developments in California. Competition between uses with respect to the timing of water availability has increased during the past several decades. In response to declining fish and wildlife populations, water flow and timing requirements have been set for certain fish and animal species that are dependent on freshwater flows. In some cases, these additional environmental water requirements have decreased the predictability of water supply for other uses.

California's human population is expected to continue to climb in the next 50 years. Demand for drinking water and water for industry will grow. Agricultural water demands are expected to decline slightly due to more efficient methods, shifts in crops, and land moving out of agriculture and into urban use. Water storage and delivery systems involving the Delta will play a key role in meeting future demands.

Most parties agree that the Delta does not currently function well in a dual capacity as an important part of the natural system and as an essential cog in the state's water supply network. One problem is that the transport of water through the Delta to the export pumps tends to draw salt from the ocean into the Delta, which decreases the quality of water being exported. The reliability of water supplies is increasingly uncertain due to the need to achieve a balance among municipal, industrial, environmental and agricultural uses.